MASTER OF PRODUCTION ENGINEERING EXAMINATION, 2018

(2nd Semester)

ADVANCED TOPICS OF OPERATIONS RESEARCH

Time: **Three hours** Full marks: **100**

Answer any THREE questions from GROUP A and any TWO questions from GROUP B. All questions carry equal marks.

GROUP - A

1. a) Solve the following problem using genetic algorithm. (14)

Maximize $f(x_1,x_2) = (x_1 - 2)^2 + (x_2 - 3)^2$

Subject to the constraint $0 \le x_1,x_2 \le 7$.

Perform at least three iterations.

b) What are the main advantages of non-conventional optimization techniques over the conventional techniques? (6)

2. a) Using the Interval Halving method, solve the following NLP problem: (10)

Minimize $f(x) = x(x - 3)$ in the interval (0, 6.00) within 10% of the exact value.

b) Write short notes on the following two: (5x2)

i) Ant coiony optimization technique and ii) Artificial bee colony optimization method.

3. a) Use dynamic programming method to show that (10)

$p_1 \log p_1 + p_2 \log p_2 + \ldots + p_n \log p_n$

Subject to the constraint $p_1 + p_2 + \ldots + p_n$ and $p_i \ge 0$ for all i

is minimum when $p_1 = p_2 = \ldots = p_n = 1/n$

b) A manufacturing company produces two types of screws, i.e. metal and wooden. Each screw has to pass through the slotting and threading machines. The maximum time that each machine can be run is 150 hours per month. A batch of 50 wooden screws requires 2 minutes on the threading machine and 3 minutes on the slotting machine. Metal screws of the same batch size require 8 minutes on the threading machine and 2 minutes of the slotting machine. The profit contribution for each batch of wooden and metal screws is Re. 1 and Rs. 2 respectively. Formulate and solve this problem as an integer LP problem in order to determine the optimal product mix for maximum profit contribution. (10)

4. a) Derive the necessary mathematical expressions for Golden section method. (8)

b) Solve the following NLP problem using Dichotomous Search method: (12)

Minimize $f(x) = x(x - 2.5)$ in the interval of (0,3.00) within 10% of the exact value assuming $\delta = 0.001$.

5. a) Using dynamic programming method, solve the following LP problem: (12)

Maximize $z = 3x_1 + 5x_2$

Subject to $x_1 \leq 4$, $x_2 \leq 7$, $3x_1 + 4x_2 \leq 15$, $x_1, x_2 \geq 0$

b) State the roles of reproduction, crossover and mutation operators in genetic algorithm. (8)

EX/PG/PROD E/T/127B/2018

M.E. PRODUCTION ENGINEERING FIRST YEAR SECOND SEMESTER EXAMINATION, 2018

ADVANCED TOPICS OF OPERATIONS RESEARCH

Time: Three Hours Full Marks:100

Part-II (40 Marks)

Use Separate Answer scripts for each part

Answer any TWO questions

6. a) Obtain the dual of the following LPP:

Maximize $Z = x_1 + 2x_2 + x_3$

Subject to: $3x_1 + x_2 - x_3 = 2$

$-2x_1 + x_2 - 5x_3 \geq -6$

$4x_1 + x_2 + x_3 \leq 6$

$x_1, x_2 \geq 0$

b) What is the economic interpretation of Dual LPP?

c) What is post optimality analysis? Discuss its significance.

d) What do you understand by simple queuing model?

e) How do you determine the optimal level of service with respect to cost analysis of a queuing system?

(6+3+4+3+4)

7. A manufacturer can produce four items P, Q, R and S. The unit profit of the items are Rs. 70,65, 80 and75 respectively. The items P, Q, R and S consume 4, 4, 3 and 7 kg raw material of first kind respectively. Raw material of first kind for production of the items is limited to 90 kg per week. The items P, Q, R and S consume 6, 3, 5 and 4 kg raw material of second kind respectively. Raw material of second kind for production of the items is limited to 120 kg per week. The items P, Q, R and S consume 5,2, 3 and 3 hrs of machine time respectively. Machine time for production of the items is limited to 60 hrs per week. The items P, Q, R and S consume 6, 5, 1 and 2 hrs of labour time respectively. Labour time for production of the items is limited to 100 hrs per week.

The optimal simplex tableau is given as follows:

Basis VbCb	x1	x2	x3	x4	S1	s2	s3	s4	bi
x2	-1/2	1	0	2	1/2	0	-1/2	0	15
S2	-5/2	0	0	-1/3	1/6	1	-11/6	0	25
x3	2	0	1	-1/3	-1/3	0	2/3	0	10
S4	13/2	0	0	-23/3	-13/6	0	11/6	1	15

[PTO]

i) Construct the Primal and Dual LPP.
ii) Construct the optimal simplex tableau for Primal and Dual LPP.
iii) Determine the ranges of raw materials, and labour hour and machine hour for which the optimal solution remains unchanged.
iv) Determine the range of unit profit of items for which optimal solution remains unchanged.

(2+6+6+6)

8. a) What are the application areas of queuing theory?
b) A service station can service one breakdown machine in 20 minutes on the average. The breakdown machines are registered at a single counter. Breakdown machines are arrived at the service station at an average rate of two machines per hour. Assuming breakdown machine arrivals rate are Poisson distributed and the servicing times are exponentially distributed, determine the followings:
    i) The probability that the system is idle;
    ii) The probability that there will be three breakdown machines in the system;
    iii) The expected numbers of breakdown machines waiting in the queue as well as in the system;
    iv) The average waiting time of a breakdown machine in the queue as well as in the system.
c) A factory operates 8 hours every day and has 240 working days per year. It buys a large numbers of small machines which can be serviced by its maintenance engineer at a cost of Rs. 40 per hour for the labour and spare parts. The machine can alternatively be serviced by the supplier at an annual contact price of Rs.2,00,000 including the labour and spare parts needed. The supplier undertakes to send a repairman as soon as a call is made but in no case more than one repairman is sent. The service time of the maintenance engineer and the supplier's repairman are both exponentially distributed with respective mean of 1.7 and 1.5 days respectively. The machine breakdown occur randomly and follow Poisson distribution with an average of 2 in 5 days. Each hour that a machine is out of order, it costs the company Rs. 80. Which alternative would you advise it to opt for?

(5+8 +7)